REPORT

ON THE

CAWNPORE EXPERIMENTAL FARM OPERATIONS

DURING THE KHARIF SEASON, 1881.

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CAWNPORE EXPERIMENTAL FARM OPERATIONS

During the Kharif Season of 1881.

No. 416A OF 1882.

FROM

W. C. BENETT, ESQ.,

Offg. Director, Dept. of Agri. and Commerce, N.-W. P. and Oudh,

To

THE SECRETARY TO GOVERNMENT,

North-Western Provinces and Oudh.

DATED CAWNPORE, THE 28TH MARCH, 1882.

SIR,

I HAVE the honor to submit Mr. Fuller's report on the kharif harvest on the Experimental Farm at Cawnpore. The delay in its submission has been due entirely to the lateness of the cotton pickings. The greater part of that crop not having been sown till a month after the usual time, the pods continued to be thrown out till after Christmas. After that it was necessary to gin a rather large crop, and to obtain the opinion of experts on the prices which the produce would command in the market, in order to strike the value per acre of the crop.

2. It was a singularly unfortunate year for experiments. The effects of the various kinds of manure were neutralised by the excessively heavy rain in August and September, which, by flooding the lower lands, gave higher-lying fields an advantage quite independent of their manner of cultivation. Moreover, the manure itself was washed from one field and deposited in another lying below it, and injured by excessive wet. The experiments in manures have therefore proved complete failures, and cannot be said to teach anything.

3. The deep and shallow ploughings were in the same way equalised by the very heavy rain, which loosened the soil to the utmost depth required by the cotton with which it was sown. These experiments did however show, what has indeed been repeatedly proved before, the immense advantage of ploughing the land a considerable time before the crop is sown. In the case of cotton it nearly doubled the outturn, raising the value of the produce from Rs. 33-5-0 to Rs. 55-3-0 per acre. I think that Mr. Fuller is mistaken in considering that the knowledge of the benefits of early ploughing is confined to the Meerut Division. They are certainly fully appreciated all over Oudh. No doubt the land is far better exposed by the farm plough than by the native implement, and that gives the former a great advantage for this operation. This year's results in no way vitiate the conclusions drawn from last year's experiments as to the immense advantage of deep ploughing in a year of drought.

4. The outturn of this year's cotton was nearly 162lbs. of cleaned cotton to the acre. This is not so good a result as was obtained last year; but, considering that the land was neither manured or irrigated, cannot be considered as otherwise than satisfactory. The provincial average outturn per acre was last year less than 66lbs. of clean cotton; and, with one exception, the highest rate of produce (252lbs. per acre) was obtained on the Cawnpore farm from country seed. This year's experiments with native and imported cotton point to one interesting fact, though the experience of a single year can hardly be taken as final proof. On light loamy soils the native cotton easily beat the American. Its produce being 195 and 252lbs. of cleaned cotton to the

acre, against 106 and 91·5lbs.; and this result is confirmed by the fact that the produce of duplicate plots sown with the same seed closely agreed. On a heavy loam, however, the superiority of New Orleans over the Kulpahar variety was equally striking : the former yielding 263lbs. of cleaned cotton against 126lbs. of the latter.

5. The experiments in sorgho sugar were vitiated by a want of proper acquaintance with the means by which it should be manufactured from the juice. The experiments, which have considerable interets, will it is hoped be repeated next year with a fuller knowledge, and consequently more satisfactory results.

6. I think that the Kaiser plough has probably a future in the cultivation of the country. It again gained the first prize at the Lucknow exhibition, and very favourable reports are received of its working from such competent judges as the indigo-planters of Tirhoot. Mr. Cabaniss of Purneah writes that he considers it the very best plough for Indian agriculture, with the exception of the Watts' (American) cast-iron plough, a much more expensive implement ; and that in some respects it is better suited to India than even that. A large number have been sent to the Panjáb, and some to almost every part of India. In Pilibhít I casually found a zamíndár who had twelve of them working on his *sír*, the majority of which he had made up in his own village in imitation of ploughs sent him from the farm. In Fatehgarh I quite accidentally came across another zamíndár who was using one of the farm ploughs. Its benefits are not immediately appreciable. It is necessary at any rate to wait till the next harvest, and perhaps for two, till they are fully apparent. Its progress therefore must be slow.

7. Another point to be noted is that it is not fitted for every class of soil. Nor indeed could any plough be devised that would be. Where the race of plough-bullocks is exceedingly poor and feeble, its draught is too great for them. But this is not the case with the majority of districts in these provinces. Where again the soil is very heavy, it suffers from the opposite defect. It is too light in construction. The Superintendent of the Government Farm at Khandesh reports that it is useless, as the soil there requires ploughs which weigh from 100 to 130lbs. The same complaint comes from the sugar cultivators of Muzaffarnagar. They want a heavier implement. Nothing lighter could be made that should at the same time be effective, but the attention of the department will in the ensuing year be turned to the development of a plough which, without being materially dearer, will answer better for heavy cultivation.

8. Many inquiries are made after the departmental pump, and a few have been sold. Considering its cheapness and effectiveness, I cannot doubt that it will before long come into very general use. I may perhaps be permitted to record a case which occurred in Lucknow. A common cultivator, who had seen the pump at work during the exhibition, asked his village blacksmith for how much he could furnish one. The man undertook to do it for Rs. 120, the real price of the pump being Rs. 40 only, and constructed an implement with the tube made of tin, with edges at the joints turned inwards. Of course after a few days' use the pump altogether broke up, and the cultivator sued the maker in the Small Cause Court to recover the price.

9. The success of the Bihia mill has been due to a large extent to the intelligent way in which its sale has been pushed. Our implements have been thrown back by the difficulty we have experienced in getting trustworthy agents. As soon as this difficulty—which is not an insuperable one—is overcome, there is I think every prospect of a large sale for the pumps certainly, and probably for the ploughs.

I have the honor to be,

SIR,

Your most obedient servant,

W. C. BENETT,

Offg. Director, Dept. of Agriculture and Commerce,

North-Western Provinces and Oudh.

REPORT ON THE CAWNPORE EXPERIMENTAL FARM FOR THE KHARÍF SEASON OF 1881.

I.—Field experiments.

THE season under report was by no means a favourable one for experimental cultivation. The rains commenced early, there being a fall of over five inches during the first fortnight of June. Advantage was largely taken of the opportunity thus afforded of getting the cotton-seed into the ground early; but a break of nearly three weeks, during which the hot winds again commenced blowing, parched up the young plants as they germinated, and the cotton sown on the first burst of rain did not on the whole do as well as that sown during July, after the rains had set in thoroughly. The rainfall of July and August was abnormally heavy, flooding a great portion of the country, and doing serious damage in this way to the young cotton and maize; but the whole season's rain was concentrated in these two months, and by the end of August the rains had practically ceased. Details of the rainfall are given below :—

Month.	Rainfall in inches.	Number of days on which rain fell.
June	5·5	4
July	12·4	15
August	17·3	22
September	0·4	3
October	0·2	1
November	0·0	0
Total	35·8	45
Normal rainfall during this period ...	26·56	...

The rainfall of September and October was actually one inch less than it was in the year preceding, when the total rainfall only amounted to between six and seven inches. The shallow-rooted millets and maize suffered severely in consequence, and yielded an outturn much under the average. Unirrigated rice totally failed. Cotton, pulses, and til did not feel the drought so much, and rather benefited than otherwise by the absence of October rain, which is often very prejudicial to them. But the ground rapidly lost the moisture which it had acquired during the two preceding months, and the rabi sowings germinated very poorly, except where the ground had been previously watered. The average outturn of clean cotton on the farm was 161·8lbs. on 6·7 acres; and considering that only one-tenth of this area was manured and none of it irrigated, this return must be considered satisfactory.

2. The excessive rainfall of July and August was especially prejudicial to the experiments, which were conducted with different manures, and to test the value of deep cultivation. The experimental fields were covered with water for over a week, and since they are situated on a slope, the manures must have been in great part washed out of the soil, and carried in solution from one plot to another. Moreover, the plots being on a slope did not all suffer equally from flooding, and this by introducing a second variant into the experiment tended of course to obscure the relative effect of the manures. The swamping of the ground also reduced deep and shallow cultivation to a par, since it converted the soil into a quagmire, and made it equally easy of penetration by plant roots, whether the ploughing was deep or shallow.

3. The operations of the season under report comprised experiments on—

(i) Manures.
(ii) Deep and shallow tillage.
(iii) Cottons.
(iv) Sugar manufacture from the Impee or Sorgho (*Sorghum saccharatum*).

4. (i) **Experiments on manures.**—These were continued on the experimental plots (each of 400 yards square) which have been mentioned in preceding reports as having been marked out for the purpose; and which, having been similarly cropped during the two preceding seasons, must have been tolerably well reduced to a level as regards natural fertility. The results exhibit some

startling discrepancies, due, as has already been explained, to the submergence of a number of the plots for over a week at the end of July, but they are given as they stand below, together with details of cultivation :—

Treatment on account of crop experimented with.				*Previous treatment.*		
Ploughing.	Seed and rate per acre.	Irrigation.	Weeding.	Year.	Manure.	Crop.
Twice with earth-turning plough...	Maize, 6 seers...	*Nil.*	Twice ...	1878-79 ...	*Nil.*	Barley.
				1879-80 ...	*Nil.*	Cotton.
				1880-81—		
				Kharif...	Same as now applied.	Maize.
				Rabi ...	Ditto.	Wheat.

The land had therefore been cropped continuously for three years, and during the preceding year had borne two very exhausting crops.

The following table shows the manures experimented with and the results they yielded. To indicate the effect of the flooding on these results a column is added, showing the outturn of wheat, which was obtained *from the same plots with the same manures*, though in slightly different proportions, during the preceding rabi season :—

Manure and rate per acre.	Cost of manure per acre.	Outturn of maize (grain) in lbs. per acre.	Outturn of wheat (grain) from same plots in the preceding rabi.	Total cost of cultivation, including harvesting and cleaning.	Value of grain produced per acre.
	Rs.	lbs.	lbs.	Rs.	Rs.
Manures yielding nitrogen—					
Poudrette, 180 maunds	9·0	1,458	1,884·6	22·1	19·5
Cattle-dung, 180 maunds	9·0	633	1,346·1	21·4	8·5
Cattle-dung, 180 maunds, and bone-dust, 360lbs.,	13·5	630	...	25·75	8·4
Cattle-dung, 180 maunds, and gypsum, 240lbs.,	14·25	1,218	1,240·3	27·0	16·3
Manures not yielding nitrogen—					
Ashes of 180 maunds cattle-dung ...	9·0	723	1,113·2	21·5	9·7
Bone superphosphate, 240lbs.	11·5	213	986·1	23·3	2·8
Bone-dust, 360lbs.	4·5	963	795·5	17·1	13·0
Gypsum, 240lbs.	5·25	1,038	...	17·9	14·0
No manure	0·0	1,239	707·8	12·8	16·6

While therefore the outturns of the preceding season showed that the efficiency of a manure depended in chief measure on the supply of nitrogen which it yielded, the present outturns, although keeping poudrette as before at the head of the list, indicate that no manure at all is considerably more efficacious than any of the other manures experimented with, whether they are nitrogen-yielding or not. This result is due to the more favourable situation of the non-manured plot which lay at the head of a slope, and was therefore less swamped than the others. Any attempt at criticising results which exhibit such discrepancy would of course be futile.

I may mention that arrangements have been completed for continuing these experiments in duplicate in future, which will do much to prevent the re-occurrence of such a failure as this. Under any circumstances, the average of two plots in different situations will be a much more reliable guide than the outturn of a single one.

Two double sets of plots—one double set for the *rabi* season and another for the *kharif*—were marked out a year ago ; but before commencing experiments it was necessary to take at least a couple of crops off the ground in order to reduce the plots to an equality.

5. **(ii) Experiments on deep tillage.**—These were continued on the plots (each of 400 square yards) which had been made the subjects of a similar experiment in the preceding year. The crop experimented with was cotton, that in the preceding year having been sorgho. The plots had not been manured for three years, received no irrigation, but were twice weeded.

No. I. was ploughed with the earth-turning plough two months before sowing, and again at sowing time.

Nos. II. and III. were ploughed once with the earth-turning plough at sowing time.

No. IV. was ploughed twice with the native plough at sowing time (this plot had never been touched with any plough but the native).

The outturns are shown below :—

Number of plot and description of tillage.	Comparative cost of tillage per acre.	Outturn of clean cotton per acre.	Cost of cultivation, including picking and ginning *	Value of produce per acre
		lbs.	Rs.	Rs.
I.—Deep ploughed two months before sowing and again at sowing time	3 0	252	22 6	55 3
II. and III.—Deep ploughed at sowing time ...	1 5	{ 141 / 165 }	18·0	33 5
IV.—Country ploughed at sowing time	1 0	177	18 3	38 8

The country plough therefore under similar circumstances gave rather better results than the English plough ; but this, as has been explained before (para. 2), is due to the swamping of the ground, the soil being saturated with moisture to a considerable depth in either case, and the plant roots therefore finding soft earth to whatever depth they penetrated. The results of the experiments of the previous kharíf prove beyond doubt that had the season been one of deficient rainfall, when it is a matter of moment that every drop of rain should be drunk in as deeply as possible, the results of the trial would have been widely different.

The outturn of plot I. shows how very largely a ploughing during the hot months increases the outturn. There was no comparison between this field and the others in strength of plants and colour of foliage, and this too although it was the one which suffered most from flooding. This result is is corroborated by the outturn of sorgho on these same plots during the preceding year ; and the corroboration is all the more striking, since it was plot No. II. which was then early ploughed, and not plot No. I. as in the present case. The increase in outturn is therefore plainly not due to any natural superiority of soil. I compare the results of the two seasons below :—

Season.	Crop	Tillage.	Outturn per acre.	Increase per centum due to early ploughing.
			Green fodder, maunds.	
Kharíf, 1880 ...	Sorgho ...	Early ploughed (No II.)	121	...
		Ploughed at sowing time (No. I.) ...	60	106
			Clean cotton, lbs.	
Kharíf, 1881 ...	Cotton ..	Early ploughed (No. I.)	252	...
		Ploughed at sowing time (No. II.) ...	141	178

In the Meerut Division the benefits of early ploughing are well known, and advantage is taken of any rain which falls between December and May to plough up all fields which are to bear a crop in the ensuing kharíf. This practice appears to be seldom if ever followed in the Agra and Allahabad Divisions, possibly because the occurrence of winter rains is so uncertain as to have given the custom no opportunity of taking root. For such a ploughing the earth-turning plough is especially advantageous, since by its use the object of the ploughing, *i.e.*, to loosen the earth and expose it to atmospheric influence, is accomplished far more thoroughly and expeditiously than is possible with the native implement.

6. **(iii) Experiments with indigenous and imported varieties of cotton.**—The total area under cotton during the season under report amounted to 6·71 acres, which yielded an average outturn of 161·81lbs. per acre. Considering that none of the land had been freshly manured, and that no irrigation was used, this result is a satisfactory one, representing as it does an average return of over Rs. 34 peracre, on an outlay of about Rs. 18.

Trials of Central India cotton from Hinganghát, and of the varieties of American cotton known as New Orleans and Upland Georgian, were made on two classes of soils,—on a light loam,

*Cost of picking estimated at value of one-twelfth of produce cost of ginning at 2 annas per 10lbs.

which had been lightly manured in the previous year, but had since borne a crop of wheat; and on a heavier loam, which had not been recently manured, but which had lain fallow for a year and a half, and was therefore the stronger soil of the two.

In the first series the imported cottons were tried against two varieties of country cotton,—that grown in Bundelkhand, known as *Kulpahar*, and that commonly grown round Cawnpore. In the second series they were tried against the *Kulpahar* variety of country cotton only. The method of cultivation followed in each case is shown in tabular form below:—

Number of experiment.	*Treatment on account of crop experimented with.*					*Previous treatment.*		
	Ploughing.	Seed and rate per acre.	Manure and rate per acre.	Irrigation.	Weeding.	Year.	Manure.	Crop.
I. ...	Once ...	Sown broadcast at 6 seers.	*Nil.*	*Nil.*	Twice ...	1879-80 ...	Guano, 1·2 maunds.	Wheat.
						1880-81 ...	Dung, 270 maunds.	Wheat.
II. ...	Once ...	Ditto ...	*Nil.*	*Nil.*	Once ...	1879-80 ...	Poudrette...	Maize.
						1880-81 ...	*Nil.*	*Nil.*

The outturns which were obtained are shown below:—

Number of experiment and class of soil.	Name of variety.	Area of plot.	Outturn in clean cotton per acre.	Cost of cultivation per acre, including picking and ginning.	Value of produce per acre.
		Acre.		Rs.	Rs.
I.—Light loam ...	American New Orleans ...	·12	104·0 } average 106·8	16·8	26·0
	Ditto duplicate plot ...	·11	109·75 }		
	American Upland Georgian ...	·11	90·75 } average 91·5	16·3	22·3
	Ditto, duplicate plot ...	·10	92·25 }		
	Hinganghát	·09	128·5	17·4	29·3
	Kulpahar	·10	194·75 } average 195·3	19·8	45·2
	Ditto, duplicate plot ...	·10	196·0 }		
	Cawnpore	·10	252·0	21·7	55·3
II.—Heavy loam ...	American New Orleans ...	·11	263·0	21·8	60·9
	Ditto Upland Georgian ...	·22	137·75	17·6	31·9
	Hinganghát	·18	91·5	16·0	21·1
	Kulpahar	·21	126·75	17·2	29·3

The results of the duplicate plots in the first series exhibit a most satisfactory correspondence.

The experiments would therefore appear to prove—(1) that for light poor soils the indigenous cotton is by far the most profitable; but (2) that on better class soils and with careful cultivation American New Orleans cotton can be grown with very great success and profit. That the local variety should be the one best suited for unfavourable conditions was of course to be expected, but it is very satisfactory to have proved that the cultivation of a high class American cotton in these provinces only necessitates a moderately good soil and moderately careful cultivation. About 20 per cent. of the area under cotton in these provinces is land under very high cultivation, and there is therefore a wide field for the introduction of American varieties.

The rates on which the outturns of the several plots have been valued are much to the disadvantage of the American varieties, since American cotton not being regularly on the Cawnpore market, only commands there a price equal to that of the best Bengal.

Fresh seed of the New Orleans variety was obtained from America and sown during the season under report, but it germinated very poorly, and only yielded sufficient produce to serve as seed for next kharif season. It is satisfactory to note however that the quality of American

cotton does not appear to deteriorate on acclimatization in this country, since some of the farm produce, grown from seed which had been acclimatized for at least four years, was pronounced by experts fully equal to good American-grown cotton.*

7. (iv) **Experiments on the manufacture of sugar from sorgho (Sorghum saccharatum).**—Hitherto sorgho has only been grown on the farm as a fodder crop, but an attempt was made during the season under report to follow experiments recently made in America with a view to test its value as a sugar-producer. Sorgho requires less than one-third of the time and expense which are necessary for a crop of sugarcane, and hence its cultivation would appear to promise well, if it can be made to produce a sufficient quantity of the coarse sugar used in the country.

The points to be settled at the outset were—(1) the variety of sorgho which contained most saccharine matter; and (2) the period of growth at which the saccharine matter was most fully developed, and at which therefore the plant should be cut.

The extent to which sorgho is cultivated in America has led to the development of a large number of varieties; but in India there appear to be only two,—the black-seeded, an introduction from China, and the red-seeded (or Impee), which has it *habitat* on the east coast of Africa. Unfortunately, only a very small amount of seed of the latter variety could be obtained, and experiments were therefore confined to the black-seeded variety.

Eight successive experiments were made at intervals of about a week, in order to discover the age at which the plants should be cut. The juice was expressed by one of Messrs. Thomson and Mylne's small vertical roller-mills, and boiled down in a single evaporating pan. The results are shown below :—

Date of sowing.	Date of cutting.	Number of days between sowing and cutting.	Weight of stems.	Weight of sugar.	Percentage of sugar to stems.
			lbs.	lbs.	
June 16th	August 29th ...	74	193	3·75	1·9
Ditto (duplicate experiment) ..	Ditto ...	74	171	3·25	1 9
May 4th	August 30th ...	118	166	10 0	6·0
Ditto	September 5th ...	124	113	4·25	3·7
Ditto	Ditto 13th ...	132	66	6·5	9·9
Ditto	Ditto 20th ...	139	122	7·25	6·0
Ditto	Ditto 27th ...	146	86	3·5	4 0
June 16th	October 4th ...	153	90	2·5	2·7

The stems should therefore be cut after from 4 to 4½ months' growth, when the seeds have almost ripened.

The sugar obtained was of the consistency of treacle, and could not be made to crystallize. It would only command a sale for tobacco sweetening at about Re. 1-12-0 per maund, and at this rate would yield no profit. This was no doubt in great part due to defects in the boiling process and inexperience of the sugar-maker; but I may mention that the difficulty of effecting proper crystallization has been found the main obstacle to the use of sorgho as a sugar-producer in America, although the recent experiments of Professor Collier, Chemist to the Agricultural Department at Washington, have shown that with certain treatment a fair proportion of sugar crystals can be obtained.

The experiments will be continued during the following kharíf, trials being made with red-seeded as well as black-seeded sorgho, and also with a variety which has been proved to be the best in America (Minnesota amber corn), some seed of which has been received from the Government of India. Greater care will be taken in the process of boiling and concentration, and the services of an experienced sugar-boiler will be engaged.

* Since this para. was written, the sale of the farm cotton has been completed with exceedingly satisfactory results. The American cotton was purchased by the Muir Mills at Rs. 25 per maund, which is 56 per cent. higher than the price ruling for "good Bengal,"—the standard quality of the Cawnpore market. The produce of ordinary country seed and of that imported from Bundelkhand was pronounced by three European cotton merchants as "equal to the finest Bengal,"—a quality not in the market this year,—and purchased at Rs. 19-2-0 per maund, which is 18 per cent. higher than that commanded by "good Bengal." This difference can only be ascribed to the effect of deep cultivation, since in no other respect did the method of cultivation differ from that followed by native cultivators.

II.—The development and manufacture of improved agricultural implements.

8. During the half-year an attempt was made to transfer to a private firm the manufacture of the Kaisar plough and the chain water-lift. The object in opening workshops at the farm was merely to provide the requisite facilities for experiments in adapting European or American implements to Indian requirements, and not to attempt to manufacture on a large scale for sale to the public. So soon as an implement appeared *primâ facie* suited to the country, it was always intended to transfer if possible its manufacture to private hands, and trust to private enterprise rather than to Government agency for pushing its sale. The Kaisar plough and the water-lift have both met with sufficient success to justify a belief that they would fill a want in Indian agriculture, and consequently their manufacture in the Government workshops was stopped, and arrangements made for transferring it to a European firm. The attempt, however, only met with failure; since, although the prices which were fixed allowed of a profit of at least 25 per cent., the workmanship was exceedingly bad, and it is feared that the reputation of the implements may have suffered considerably in consequence. The attempt is not, however, to be abandoned, but it has been necessary to re-commence manufacture at the farm, whilst opening negotiations with another firm.

The number of ploughs sent out between June 1st and November 30th, 1881, was 216, of which 205 were sold and 11 given away. Out of the 216, 123 were of Government and 93 of private manufacture.

Nineteen of the improved 20ft. water-lifts, all of farm manufacture, were distributed during the half-year, two of which were given away as samples, and the rest sold.

No winnowers were sent out during the half-year, since there was no use for them during the season which it includes.

J. B. FULLER,

Assistant Director, in charge Cawnpore Experimental Farm.